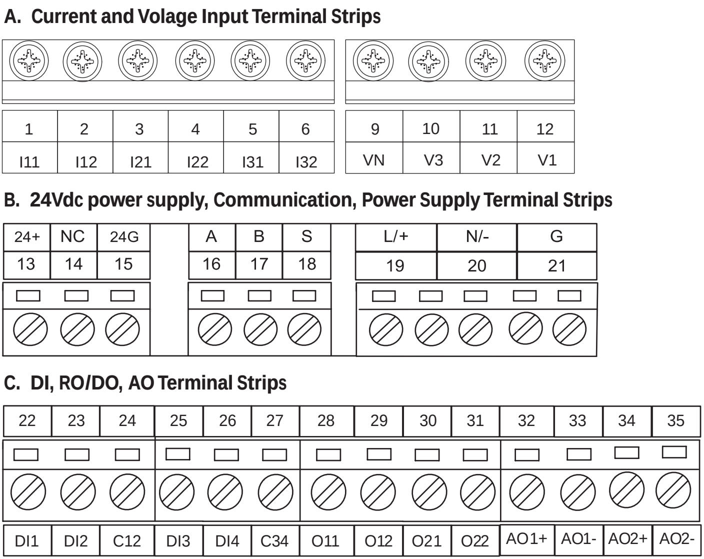


Figure 2-6 Acuvim 300 Terminal Strip

DANGER

Only qualified professionals should install, make sure the power supply is cut off and all wires are de-energized. Failure to do so may result in severe injury or death.

Safety Earth Connection

Before setting up the meter's wiring, please make sure that the switch gear has an earth ground terminal. Connect both the meter's and the switch gear's ground terminal together. The following ground terminal symbol is used in this user's manual.

Power Supply

Acuvim 300 series power supply is 100~415 Vac (50/60 Hz) or 100~300 Vdc, which is universally supported. The meter's typical power consumption is very low and can be supplied by an independent source or by the measured load line. A regulator or an uninterrupted power supply (UPS) should be used under high power fluctuation conditions.

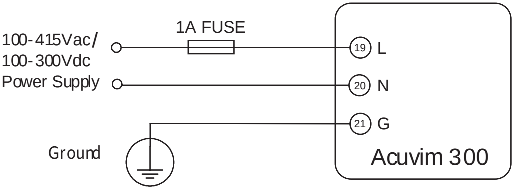


Figure 2-8 Power Supply

Choice of wire of power supply could be AWG22-16 or 0.6-1.5mm^2.

The independent power supply circuit loop must have a fuse or air circuit breaker. The fuse could be 1A/250Vac, time delay type. If circuit breaker is used, a CE certi□ed product with compliance of IEC947 is recommended.

Terminal G (21) must be connected to the ground terminal of switchgear. Anisolated transformer or EMC flter should be used in the auxiliary power supply loop if there is a power quality problem in the power supply.

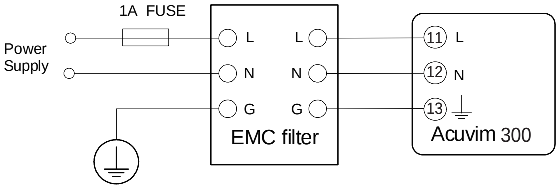


Figure 2-9 Power supply with EMC filter

Voltage Input

Voltage input range is 40~400Vac L-N, 70~690 Vac L-L. The range fits three phase low voltage system (not larger than 120V) or high voltage system that has secondary PT 100V. It also fits three phase low voltage system (not larger than 400V) or high voltage system thathas secondary PT 400V.

A fuse (typical 1A/250Vac) or air circuit breaker must be used in the voltage input loop.

Warning: In no circumstance should the secondary of the PT be shorted. The secondary of the PT should be grounded at one end. Please refer to the wiring diagram section for further details.

Please make sure to select an approprate PT to maintain the measurement accuracy of the meter. When connecting using the star confguration wiring method, the PT's primary side rated voltage should be equal to or close to the phase voltage of the system to utilize the full range of the PT. When connecting using the delta confguration wiring method, the PT's primary side rated voltage should be equal to or closeto the line voltage of the system. The wire for voltage input could be AWG16~22 or 0.6~1.5mm^2

Current Input

Current Transformers (CTs) are required in most engineering applications. Typical current rating for the secondary side of the CT shall be 5A (standard) or 1A (Optional), please refer to the ordering information appendix for further details. CTs must be used if the system rated current is over 5A. The accuracy of the CT should be better than 0.5% with rating over 3VA is recommended in order to preserve the meter's accuracy. The wire between CTs and the meter shall be as short as possible. The length of the wire may efect the accuracy. The wire size of current input could be AWG15-16 or 1.5-2.5mm^2.

Warning: The secondary side of the CT should never be open circuit in any circumstance when the power is on, otherwise it may cause damage to the unit and physical injury. There should never be any fuse or switch in the CT loop. One end of the CT loop should be connected to the ground.

Vn Connection

Vn is the reference point of the Acuvim 300 series meter voltage input. Low wire resistance helps improve the measurement accuracy. Different system wiring modes require different Vn connection methods. Please refer to the wiring diagram section for more details.

Acuvim 300 Wiring

The following introduces the wiring scenarios. Please make sure voltage input as well as PT secondary voltage, current input as well as CT secondary current are suitable for the meter. Please note the correct wiring scenario will only work properly with correct parameter setting in the meter (Chapter 3 introduces meter parameter settings).

1. Wye mode 3CT (meter setting 3Ln)

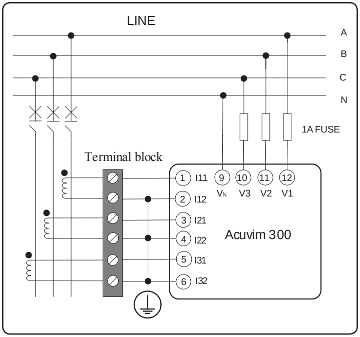


Figure 2-10 3LN 3CT connection

2. Wye mode 2CT (meter setting 3Ln)

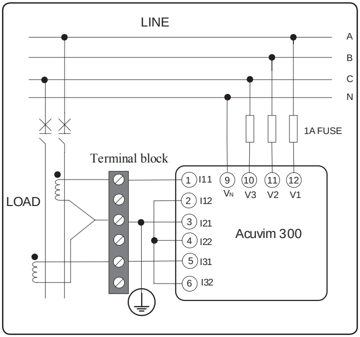


Figure 2-11 3LN, 2CT connection

3. Delta mode 2CT (meter setting 2LL)

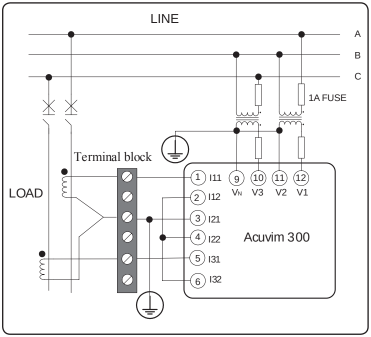


Figure 2-12 2LL, 2CT connection

4. Direct connection, 3CT (meter setting 3LL)

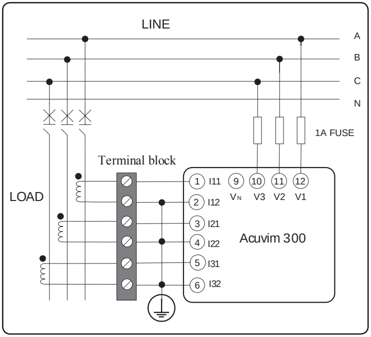


Figure 2-13 3LL, 3CT connection

5. Direct connection, 2CT (meter setting 3LL)

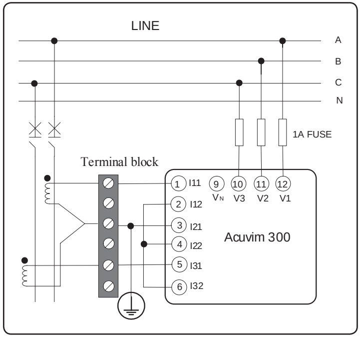


Figure 2-14 3 phase direct connection 2CT

6. Single phase 2 wire (meter setting 1Ln)

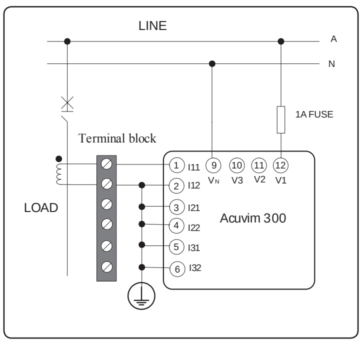


Figure 2-15 Three phase 2CT connection

7. Single phase three wires (wirng mode 3Ln)

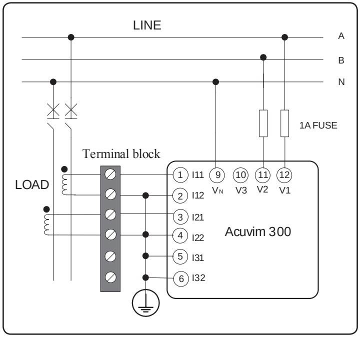


Figure 2-16 Single phase three wire connection

2.4 IO Extension

Acuvim 300 series supports 4 Digital Inputs, 1 24Vdc auxiliary power supply, 2 Relay Outputs or 2 Digital Outputs, 2 Analog Outputs.

Digital Input

Acuvim 300 provides 4 dry contact digital input circuits, the terminal numbers are C12, DI1, DI2, C34, DI3, DI4 (28, 29, 30, 31, 32, 33). DI1, DI2 share C12; D13, DI4 share C34. The simpli□ed circuit is shown below:

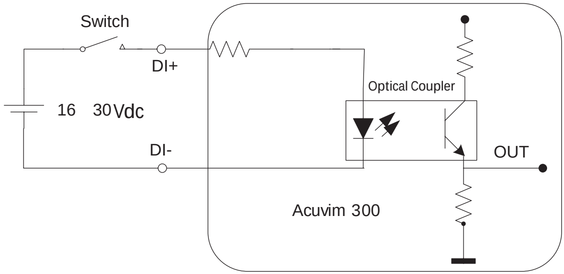


Figure 2-17 Digital Input

When the Switch is open, there is no current flow in the diode side of the optical coupler, the triode is o, OUT is in low state. When the Switch is closed, there is current flow in the diode side, the triode is on, OUT is in high state. In this way, the "high" and "low" state of OUT correspondes to "closed" and "open" state of the switch.

The recommendation of the power supply in series connection with Switch is 16-30 Vdc. If the circuit wire is long, the voltage level can be raised. However, the max current should not exceed 7.5 mA.

Acuvim 300 provides a 24Vdc DI power supply for user's convenience. The power supply is 1W, terminal blocks are 24+, 24G (13, 15). It can only be used as DI power supply, cannot be used for other purposes.

The DI power supply that Acuvim 300 provides has the following wiring scenario. Wire size is AWG 22-16 or 0.5-1.3 mm^2

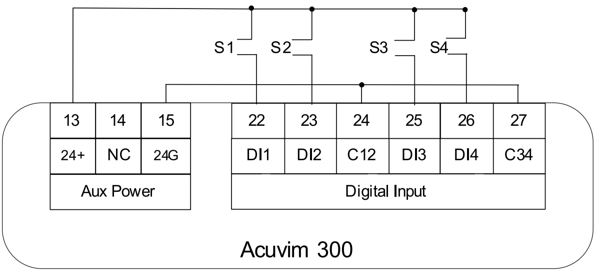


Figure 2-18 Self-Powered Digital Input

Relay Output

Acuvim 300 series IO option has two relay outputs, which can be used either as remote control operation or over/under limit alarming. The terminals are O11, O12 (28, 29) and O21, O22 (30, 31).

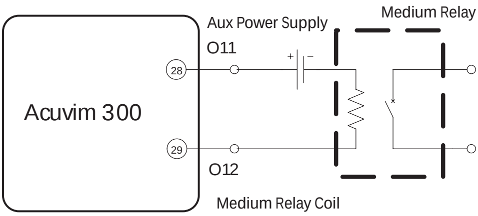


Figure 2-19 Relay Output

The relay outputs are Form A (normally open) electromagnetic relay. If normally closed relay is required, it needs to be speciﬁed when the order is placed. The nodal capacity is 3A/250Vac or 3A/30Vdc. If the coil has a high capacity, a medium replay is recommended.

The relay outputs have two options. One is latching: the output is "ON" and "OFF" state; the other is Momentary, the output changes from "OFF" to "ON", holding it for a time period "Ton" and then go back to "OFF" state. Ton time can be set as 800ms.

The relay control circuit wiring can be chosen as AWG22-16 or 0.5-1.5mm^2.

DO output

Acuvim 300 series IO extension has two Digital Output (DO), which can be used as remote control output, over/under limit alarming, energy pulse output etc.

When DO is chosen as remote control or alarm output, the output type is the same as the relay output.

The two DO can also be used as energy pulse output, which can be set as energy output or reactive energy output. The pulse constant is 800-6000, pulse width is 60ms.

DO utilizes Photo-Mos format.

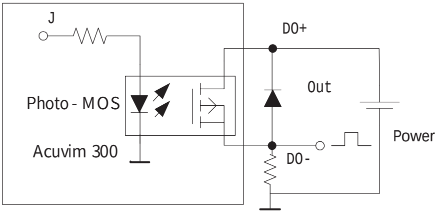
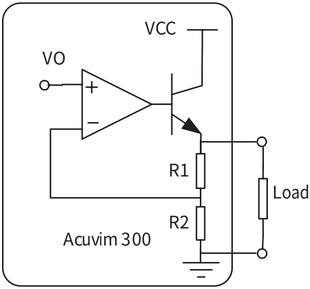


Figure 2-20 Digital Output

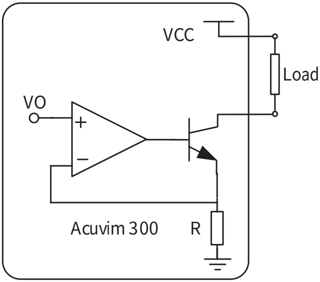
Analog Output

Acuvim 300 series offers two Analog Ouput that can be utilized in DCS system or industrial montioring and controlling equipment. By pressing the buttons or changing the communication settings, it can convert any of the 17 measured data. Please refer to Chapter 3 for detailed con gurations.

The Analog Output type is voltage type: 0-5V/1-5V (con gurable); current type: 0-20mA/4-20mA (con gurable).



Voltage Type



Current Type

Users should utilize AO within the maximum load capacity.
Current Type: max load resistance 500 Ohm
Voltage Type: max load current 20 mA

Over/Under Limit Alarming

Acuvim 300 has over/under limit alarming capability. When the monitored parameter goes beyond/below the preset limit and stays at the level over the preset amount of time delay, the over/under limit alarm will be triggered. RO1/DO1 or RO2/DO2 output can be utilized as alarming output signal.

The following example illustrates the alarming function.

When Phase B current goes above 180A (CT ratio is set as 200: 5) for over 15 seconds, over limit alarm will be triggered, alarm signal will be set out via RO1/DO1.Setting procedures should be as follows:

1) Conﬁgure RO1/DO1 output as Alarming Output, set its mode to 2;

2) Set alarming delay time as 15s;

3) Set alarming parameter as Phase B current, according to alarming parameter table, parameter should be set as 11.

4) Set alarming condition "larger than". The inequality sign should be set as 1;

5) Alarming threshold setting should be set according to:

Real value = Set value x (CT1/CT2) / 1000

180A is the alarming value, so Set value = 4500.Therefore, the setting of RO/DO has been completed. If phase B current is larger than 180A and lasts longer than 15 seconds, an alarm will be triggered.

Communication

Acuvim 300 series meter uses RS485 serial communication and the Modbus-RTU protocol. The terminals of communication are A, B, and S (16, 17 and 18). A is diferential signal +, B is diferential signal - and S is connected to the shield of twisted pair cable. The overall length of the RS485 cable connecting all devices can not exceed 1200m (4000ft). Utilizing a large number of RS485 devices and utilizing a high baud rate will make the communication range shorter. Acuvim 300 works as Slave device, Maser device can be PC, PLC, Data Acuqusition Device, or RTU.

In order to improve communcation quality, please pay attention to the following:

A high-quality Shielded Twisted Pair cable is very important, AWG22 (0.6mm2) or lower is recommended. Two cables should be different colors.

Pay attention to "single point earthing". It means there is only one point of the shielding connected to ground in a single communication link.

Every A(+) should be connected to A(+), B(-) to B(-), or it will infuence the network and possibly damage the communication interface.

"T" type connection topology should be avoided. This means no new branches except from the starting point.

Keep communication cables away as much as possible from sources of electrical noise.

When several devices are connected (daisy chain) to the same long communication line, an anti signal reflecting resistor (typical value 120-300Ohm 0.25W) is often used at the end of the circuit (the last meter of the chain) if the communication quality is distorted.

Chapter 3 Meter Display and Operation

Operational details of the meter will be described in this chapter. This includes viewing real-time metering data and setting parameters using different key combinations.

3.1 Display Panel and Keys

The front of the Acuvim 300 series meter consists of an LCD screen and four control keys. All display segments are shown in Fig. 3-1 below:

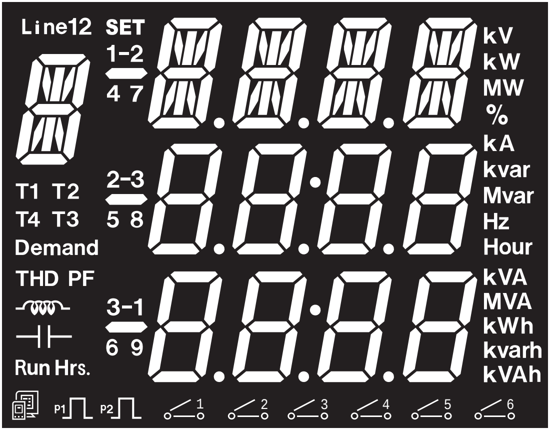


Figure 3-1 All display segments shown

Number	Display	Description
1		Mainly displays data of voltage, current, power, power factor, frequency etc.
2	Top left corner	Item icon U: voltage; I: current, P: active power; q: reactive power; PF: power factor; S: apparent power; E: energy.
3	SET	Indicates settings page display
4	Load type	Small inductor: inductive load; Small capacitor: capacitive load.
5	Communication Icon	No icon: no communication; One icon: query sent Two icons: query sent and response received
6	1	Digital Input (DI) status display
7	Unit Display	voltage: V, kV; current: A, kA: active power: kW, MW; reactive power: kvar, Mvar; apparent power: kVA, MVA; frequency: Hz; active energy: kWh; reactive energy: kvarh; apparent energy: kV Ah; Percetage: %; phase angle: °
8	PF, Demand	Indicates power factor and demand respectively
9	T1/T2/T3/T4	Indicates Critical-peak, On-peak, Mid-peak, Off-peak tariffs
10	Pulse Indicator P1	Indicator light on: pulse output; Indicator light off: no pulse output.

There are four keys on the front panel, labeled F, " ", " "and "V/A" from left to right. Use these four keys to read real-time metering data, set parameters and navigate the meter. The following illustrations outlined display and key functions of the Acuvim 390 model.

3.2 Metering Data

Acuvim 300 normally works in data display mode, which shows real-time measured data, such as voltage, current, power etc. In this mode, the "F". " ", " " and "V/A" keys can be used for a variety of functions as follows:

Press "V/A": Displays voltage and current related parameters in data display zone. Every time the "V/A" is pressed, the screen will scroll to the next screen. When the screen reaches the last one, it will go back to the first screen.

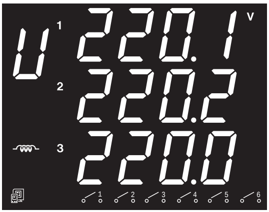


Figure 3-2 Three phase voltage

1st screen: Display phase voltage U1, U2, U3
U1=220.1V, U2=220.2V, U3=220.0V; Inductive load; Communication status is ok.
Note: communication status, load type is system information, which is displayed on every screen. Press "V/A" again to scroll to the 2nd screen.

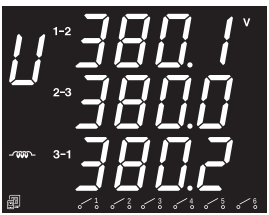


Figure 3-2 Line-to-line voltage

2nd screen: Display line-line voltage U12, U23, U31.
U12=380.1V, U23=380.0V, U31=380.2V;
Inductive load; Communication status is ok.
Press "V/A" again to scroll to the 3rd screen.

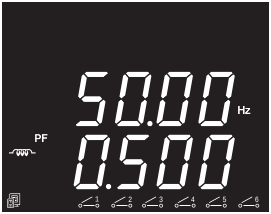


Figure 3-7 Three phase reactive power

2^{nd} screen: display system frequency and power factor.
F=50.00Hz, PF=0.500.
Press "   "to display the 2^{nd} screen.
For Acuvim 398, press "   "to display the 3rd screen.

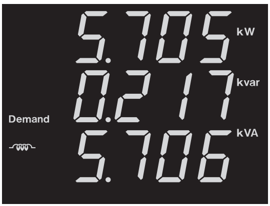


Figure 3-8 System power demand display

3^{rd} screen: display system power demand P_Demand, Q_Demand, S_Demand
P_Demand=5.705kW, Q_Demand=0.217kvar, S_Demand=5.706kVA.
Press"   " to return to the 1^{st} screen.

Note: when power display value is 9999MW, it means the measured data has already exceeded the meter display range.

Press "   ": In measured data display zone it displays energy related paramters. Every time the key is pressed, the screen will be scrolled to the next one. Press "F" to switch between circuits.

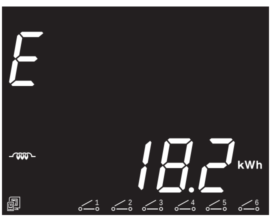


Figure 3-9 Real energy

1^{st} screen: display real energy Ep
Ep=18.2kWh, Inductive load; Press "   " again to display 2nd screen.

Figure 3-10 Reactive energy

2nd screen: display reactive energy Ep

Eq=13.2 kvarh

Press "   " again to display 3rd screen.

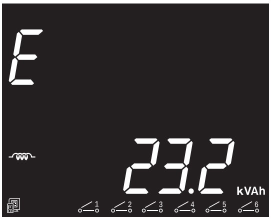


Figure 3-11 Apparent energy

3rd screen: display apparent energy Es

Es=23.2 kVAh.

Press "   " again to return to the first screen.

For Acuvim 398, press "   " again to display the 4th screen.

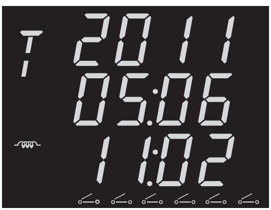


Figure 3-12 Meter clock display

4th screen: display meter current time. The time in the left figure shows 11: 02, May 6, 2011

Inductive load

Press "   " again to return to the first screen.

Press "F": display harmonics information. Every time "F" is pressed, the screen will scroll to the next screen.

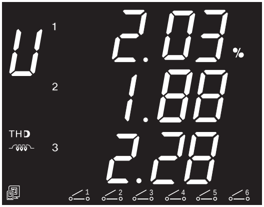


Figure 3-13 Voltage THD

1st screen: Voltage Total Harmonic Distortion

U1_Thd=2.03%, U2_Thd=1.88%, U3_Thd=2.28%; Inductive load; press“ ”to display the 2nd screen.

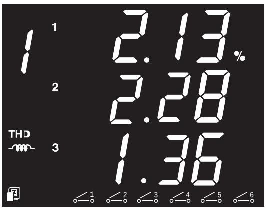


Figure 3-14 Current THD

2nd screen: Current Total Harmonic Distortion

I1_Thd=2.13%, I2_Thd= 2.28%, I3_Thd = 1.36%.

Press " " to return to the 1st screen.

3.3 Statistic Data

Acuvim 398 can display max demand and Time of Use Energy. Pressing "F" and“ ”simultaneously will display max demand. Pressing “ ”and "F" simultaneously will display "Critical-peak", "On-peak", "Mid-peak", "O□-peak" Time of Use Energy.

Press "F" + " ": display current max demand.

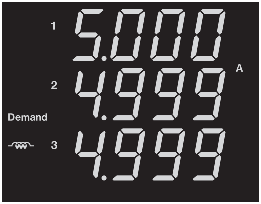


Figure 3-15 Current demand max display

1st screen: current max demand
I1_Demand_max=5.000A, I2_Demand_max=4.999A, I3_Demand_max=4.999A.
Inductive load; communication status okay.
Press "V/A" to display the 2nd screen.

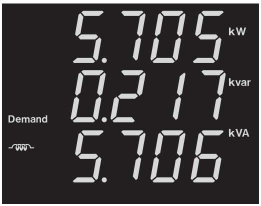


Figure 3-16 Power demand max display

2nd screen: Power demand max display
P_Demand_max=5.705kW, Q_Demand_max=0.217kvar, S_Demand_max=5.706kVA;
Inductive load
Press "V/A" to return to the 1st screen. Press "F" and “ ”to exit to voltage display.

Time of Use Energy display

Figure 3-17 "Total" energy display

Press “ ”+ "V/A": display Time of Use Energy
1st: screen "Total" energy.
Ep=698.3kWh; Inductive load
Press "V/A" to display the second screen.

Figure 3-18 "Total" reactive energy display

2nd screen: "Total" reactive energy
Eq=52.4kvarh; Inductive load
Press "V/A" to display the 3rd screen.

Figure 3-19 "Total" apparent energy display

3rd screen: "Total" apparent energy
Es=727.1kVAh; Inductive load
Press "V/A" to return to the 1st screen.
If "F" is pressed, it will display "Critical-peak" energy in the 4th screen.

Figure 3-20 "Critical-peak" energy display

4th screen: "Critical-peak" energy
Ep=93.2kWh, T1 stands for "Critical-peak"
Inductive load
Press "V/A" to display the 5th screen.

Figure 3-21 "Critical-peak" reactive energy display

5^{th} screen: "Critical-peak" reactive energy

Eq=0.0kvarh; Inductive load

Press "V/A" to display the 6th screen.

Figure 3-22 "Critical-peak" apparent energy display

6th screen: "Critical-peak" apparent energy

Es=94.6kVAh; Inductive load

Press "V/A" to return to the 4th screen. If "F" is pressed, it will display "Peak" energy in the 7th screen.

Figure 3-23 "On-peak" energy display

7^{th} screen: "On-peak" energy

Ep=116.9kWh; "T2" stands for "On-peak".

Inductive load

Press "V/A" to display the 8th screen.

Figure 3-24 "On-peak" reactive energy display

8th screen: "On-peak" reactive energy

Eq=0.0kvarh; Inductive load

Press "V/A" to display the 9th screen.

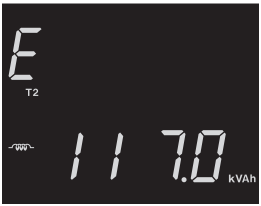


Figure 3-25 "On-peak" apparent energy display

9th screen: "On-peak" apparent energy

Es=117.0kVAh; Inductive load

Press "V/A" again to return to the 7th screen. Pressing "F" key will display "Valley" energy. Press "V/A" to switch different energy type under the same tariff. Press "F" to switch among different tariffs.

Press “ ” to display demand data of Time of Use.

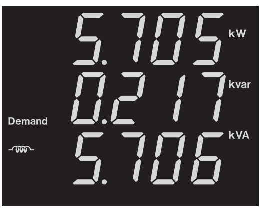


Figure 3-26 "Total" power demand display

1st screen: "Total" power demand

P_Demand=5.705kW, Q_Demand=0.217kvar, S_Demand=5.706kVA;

Inductive load

Press "V/A" to display the 2nd screen.

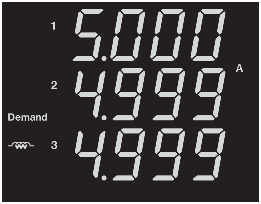


Figure 3-27 "Total" current demand display

2nd screen: "Total" current demand

I1_Demand=5.000A, I2_Demand=4.999, I3_Demand=4.999A;

Inductive load

Press "V/A" to return the first screen. If "F" is pressed, the 3rd screen "Critical-peak" power demand will be displayed.

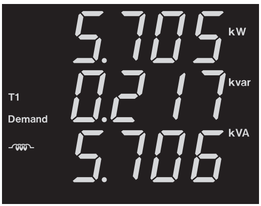


Figure 3-28 "Critical-peak" power demand display

3rd screen: "Critical-peak" power demand

P_Demand=5.705kW, Q_Demand=0.217kvar, S_Demand=5.706kVA; "T1" stands for "Critical-peak".

Inductive load

Press "V/A" to display the 4th screen.

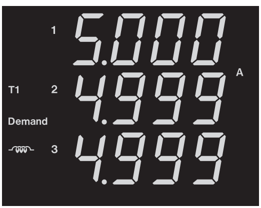


Figure 3-29 "Critical-peak" current demand display

4th screen: "Critical-peak" current demand

I1_Demand=5.000A, I2_Demand=4.999A, I3_Demand=4.999A; Inductive load; Press "V/A" to return to the 3rd screen.

Pressing "F" key will display "On-peak" power demand. Press "V/A" to switch different energy type under the same tariif. Press "F" to switch among different tariffs.

Press " " to return to "Total" power demand. Press " " and "V/A" to exit to voltage display.

3.4 System Parameter Setting

Pressing "F" and "V/A" simultaneously will activate the parameter setting mode. At the same time, "SET" is displayed on the top left corner.

In parameter settings mode, "F" key is to move the cursor. Every time the key is pressed, the cursor will move one digit to the right, the number where the cursor stays will be flashing. "   " is to increase the value, "   " is to decrease the value. "V/A" key is for confirmation on the change, and scroll to the next settings screen. On any parameter setting screen, pressing "F" and "V/A" keys together will exit parameter settings mode and return to the measured data display mode.

Parameter settings mode is password protected. A four digit password (0000 to 9999) is required everytime before accessing the parameter settings mode. The default password is 0000.After entering the password, press "V/A" to go to the parameter selection page. The meter will return to the metering mode if a wrong password is entered.

The following is the parameter settings mode:

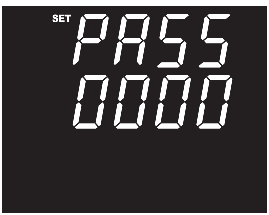


Figure 3-30 Password

Password Protection: Users need to enter the password.

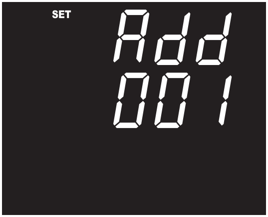


Figure 3-31 Communication address setting

1st screen: Communication address setup. It is used to set communication address, which can be any integer 1-247.The left figure shows the address is 1.To change: press "F" to move the cursor to the digit to be changed, press " " to increase value or" " to decrease value. Then press "V/A" to confirm and scroll to the next screen. If no change needs to be done, press "V/A" to scroll to the next screen.

Note: Modbus-RTU communication protocol requires that all meters on the same bus should have different addresses.

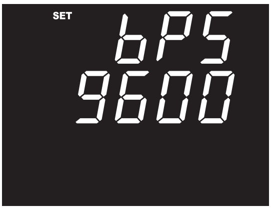


Figure 3-32 Communication baud rate setting

2nd screen: Baud rate setting page. Baud rate can be set 1200, 2400, 4800, 9600, 19200, 38400.

The figure on the left indicates the baud rate is 9600 bps. In order to change it, simply press " " or " " to choose a value from the 7 numbers. Press "V/A" to confirm and go to the next screen.

Press "V/A" key to confirm and go to the next setting screen.

Figure 3-33 Parity bit setting

3rd screen: Parity setting page. Acuvim 300 series provides parity bit setting. It can be set as Even, Odd, None 1, None 2.None 1 means 8 data bit, no parity bit, 1 start bit, 1 stop bit, no parity bit. None 2 means 8 data bit, no parity bit, 1 start bit, 2 stop bits. Parity setting. uses " " or " " to switch. Press "V/A" to go to the next screen.

Note: All devices on the same communication bus should use the same baud rate and parity setting.

Figure 3-34 Wiring mode

4th screen: Meter wiring mode setting. Wiring mode can be set as "3Ln", "3LL", "2LL". Please see Chapter 2 for details.

The figure on the left indicates 3Ln. In order to change it, simply press " " or " " to change the value.

Press "V/A" to confirm and go to the next screen.

Figure 3-35 PT1 Setting

5th screen: PT1 setting -- Primary side of PT.

PT1 range is 50.0-1000.000.0.unit is Volt. The left figure shows PT1= 400.0V. Users can use P, " " and " " to change PT1 value.

Press "V/A" to confirm and go to the next screen.

Figure 3-36 PT2 Setting

6th screen: PT2 setting -- Secondary side of PT.

The left figure shows PT2 = 400.0V. Users can use P, " " and " " to change PT2 value.

Press "V/A" to confirm and go to the next screen.

Note: If there is no PT installed, "PT1" and "PT2" should be equal to Acuvim 300 nominal input voltage (400V).

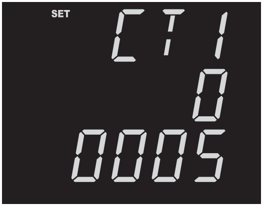


Figure 3-37 CT1 Setting

7th screen: CT1 setting -- Primary side of CT.

Acuvim 300 CT1 range is 5-50000 or 1-50000 (for 1A meter) integer, unit is Amp.

CT1=5A, Users can use P, "   " and "   " to change CT1 value.

Press "V/A" to confirm and go to the next screen.

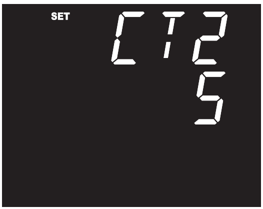


Figure 3-38 CT2 Setting

8th screen: CT2 setting -- Secondary side of CT.

Acuvim 300 CT2 is fixed as 5 or 1 (for 1A meter), unit is Amp.

CT2=5A

Press "V/A" to confirm and go to the next screen.

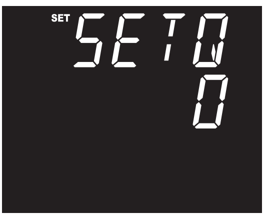


Figure 3-39 Reactive power definition

9th screen: Defnition of reactive power.

Acuvim 300 has two ways to calculate reactive power: sinusoidal reactive power and Budeanu's reactive power. Detailed information can be referred to the next chapter.

The left figure shows it is using sinusoidal reactive power

Figure 3-40 Var/PF convention

10th screen: Var/PF Convention

Acuvim 300 supports two power factor standards: IEC and IEEE.

Press “ ”and“ ” to select the standard. The left figure shows IEC is selected.

Press "V/A" to confirm and go to the next screen.

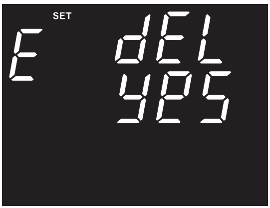


Figure 3-41 Clear energy

11th screen: clear Energy

Acuvim 300 energy can be cleared by the front keys.

Press “ ”and“ ” to switch between "Yes" and "No".

If "Yes" is selected, press "V/A" to confirm to clear the energy; If "No" is selected, press "V/A" and it will not clear the energy.

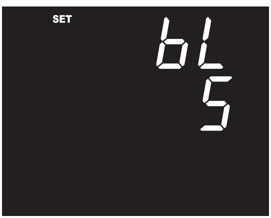


Figure 3-42 Backlight brightness

12th screen: backlight brightness setting

Acuvim 300 has 5 levels of backlight brightness. 1 is minimum light level, 5 is maximum light level.

The left figure shows leve 5, the brightest.

Press "V/A" to confirm and go to the 15th screen. For Acuvim 398, it will go to the 13th screen.

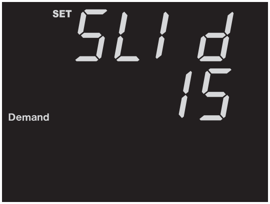


Figure 3-43 Sliding window demand

13th screen: sliding windows time for demand setting. Sliding windows time of demand can be set from 1-30 minutes. The window slides once per minute. The left figure shows demand window is set as 15 minutes. Press "V/A" to confirm and go to the next screen.

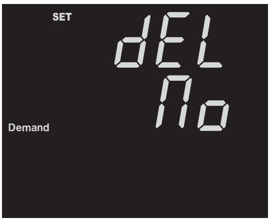


Figure 3-44 Demand clear

14th screen: demand clear

Press “ ”and“ ” to switch between "Yes"' and "No".

If "Yes" is selected, press "V/A" to confirm to clear the demand; If "No" is selected, press "V/A" and it will not clear the energy;

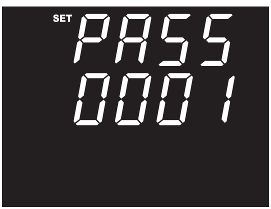


Figure 3-31 Password

15th screen: password settings

This is the last screen in system parameter setting mode. The password can be changed in this page.

It is important to remember the new password.

The left figure shows the password is set as 0001. Press "V/A" to confirm and save, and return to the first communication address setting screen.

All measuring parameter and analog output relationship is shown as Figure 3-47 and Figure 3-48.

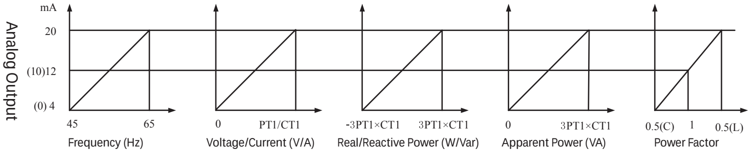


Figure 3-47 4-20/0-20 mA Analog Output

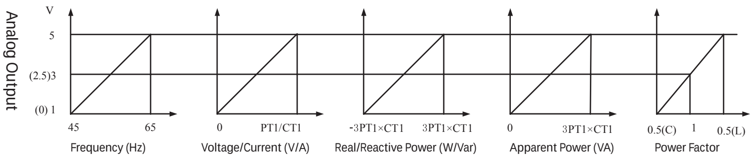


Figure 3-48 1-5/0-5V Analog Output

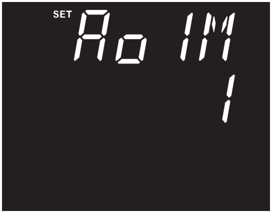


Figure 3-49 AO1 range setting

2nd screen: AO1 range setting

Acuvim 300 extended AO provides range setting.

Current AO: 0: 0-20mA; 1: 4-20mA

Voltage AO: 0: 0-5V; 1: 1-5V;

The left figure shows AO1 range is 0-20 mA or 0-5V.

Press "V/A" to go to the next screen.

Figure 3-50 AO2 parameter setting

3rd screen: AO2 parameter setting

The left figure shows that AO2 parameter is set as Ib.

Press "V/A" to go to the next screen.

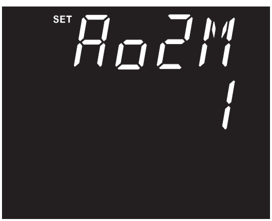


Figure 3-51 AO2 range setting

4th screen: AO2 range setting

Current AO: 0: 0-20mA; 1: 4-20mA

Voltage AO: 0: 0-5V; 1: 1-5V;

The left figure shows AO1 range is 4-20 mA or 1-5V.

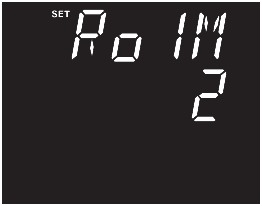


Figure 3-52 RO1/DO1 workng mode setting

5th screen: RO1/DO1 working mode setting

Acuvim 300 provides Relay Output / Digital Output. Users may only use one of them. RO/DO work mode settings range is 0-3.

0: Voltage Output; 1: Momentary output, high voltage width 800ms; 2: Alarm Output; 3: Energy Pulse Output. When the user chooses relay as output device, RO/DO working mode cannot be set as 3.The left figure shows RO/DO working mode is set as Alarm Output.

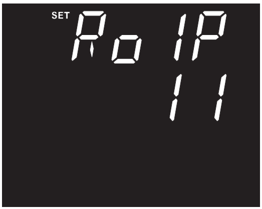


Figure 3-53 RO1/DO1 alarming parameter setting

6th screen: RO1/DO1 Alarming Parameter Setting

When RO/DO is utilized as Alarm Output, alarming parameters need to be set. For more details about Alarm Output, please refer to Chapter 2.4 Over/Under Limit Alarming.

Alarming parameter number range is 0-18, which is listed in Table 3-3.When it is set as 0, no alarm output. The left figure shows parameter is set as Ib.

Table 3-3 Alarming parameters

1	2	3	4	5	6	7	8
Hz	Ua	Ub	Uc	Uavg	Uab	Ubc	Uca
9	10	11	12	13	14	15	16
Ulavg	Ia	Ib	Ic	Iavg	In	P	Q
17	18						
S	PF						

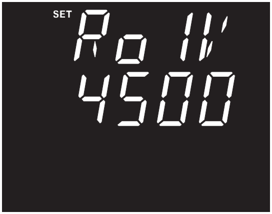


Figure 3-54 RO1/DO1 alarming setpoint setting

7th screen: RO1/DO1 Alarming setpoint setting

The alarming setpoint range is any integer between 0 and 8000.

The detailed setup methods can be found in Chapter 2.4 Over/Under Limit Alarming.

Press "V/A" to go to the next screen.

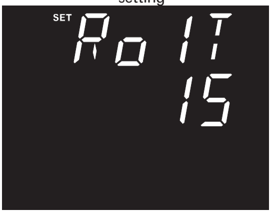


Figure 3-55 RO1/DO1 alarming delay time setting

8th screen: RO1/DO1 Alarming delay time setting

RO1/DO1 delay time setting range is 0-255, unit: second The left picture shows the delay time is 15 seconds. When the alarming condition is met, an alarm will be triggered in 15 seconds. However, if the alarming condition is not longer met, within 15 seconds, it will cancel the alarm.

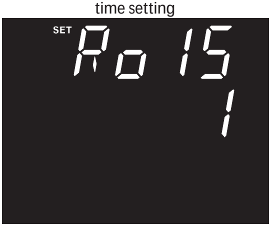


Figure 3-56 RO1/DO1 alarming inequality setting

9th screen: RO1/DO1 Alarming delay time setting

When the alarming inequality is set as 1, the condition is "larger than", which means the alarm triggering condition is when the alarming parameter is larger than the setpoint value; When the inequality is set as 0, the condition is "sallmer than", which means the alarm triggering condition is when the alarming parameter is smaller than the setpoint value. The left figure shows RO1/DO1 alarming inequality is set as 1, which means the alarm triggering condition is when the parameter is larger than the setpoint value.

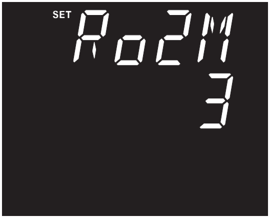


Figure 3-57 RO2/DO2 working mode setting

10th screen: RO2/DO2 working mode setting

The left figure shows RO2/DO2 working mode is set as 3 -- Energy Pulse Output.

Press "V/A" to go to the next screen.

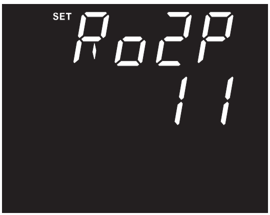


Figure 3-58 RO2/DO2 alarming mode setting

11th screen: RO2/DO2 alarming parameter setting

When RO2/DO2 working mode is set as Alarming Output, the set method is the same as RO1/DO1,

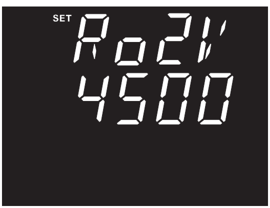


Figure 3-59 RO2/DO2 alarming setpoint setting

12th screen: RO2/DO2 alarming setpoint setting

When RO2/DO2 working mode is set as Alarming Output, the set method is the same as RO1/DO1.

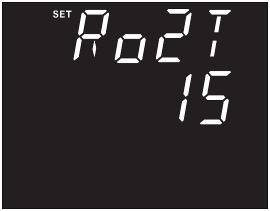


Figure 3-60 RO2/DO2 alarming delay time setting

13th screen: RO2/DO2 alarming delay time setting
When RO2/DO2 working mode is set as Alarming Output, the set method is the same as RO1/DO1.

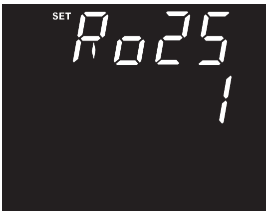


Figure 3-61 RO2/DO2 alarming inequality setting

14th screen: RO2/DO2 alarming delay time setting
When RO2/DO2 working mode is set as Alarming Output, the set method is the same as RO1/DO1.

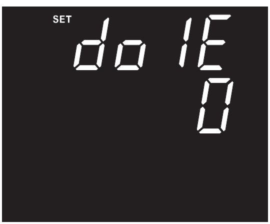


Figure 3-62 DO1 pulse energy output selection

15th screen: DO1 pulse energy output selection. Select which energy type the DO1 output is.

0 None

1: Output energy

2: Output reactive energy

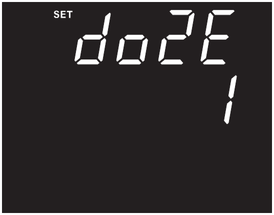


Figure 3-63 DO2 pulse energy output selection

16th screen: DO2 pulse energy output selection.
Select which energy type the DO2 output is.
0 None
1: Output energy
2: Output reactive energy

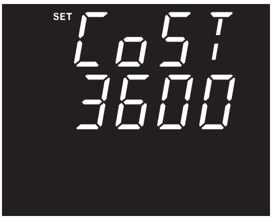


Figure 3-64 DO2 pulse constant setting

17th screen: pulse constant setting
Range: 800-6000
Unit: pulse / kWh (kvarh)
The left figure shows pulse constant is set as 3600.Press "V/A" to return to the first screen setting.
To exit extended IO mode, press "F" and “ ” simutaneously to exit to the system parameter settings mode.

3.6 Parameter Introductions

Acuvim 300 measures multiple electric paramters, which are introduced in the following:

Voltage (U): True RMS value of three phase voltages, three line to line voltages.
Current (I): True RMS value of three phase current, average current and neutral line current.
Power (P): Total system power
Reactive Power (Q): Total reactive power.

In sinusoidal or non-sinusoidal systems, reactive power meets:

$$Q_1^2 + D^2 = S^2 - P^2$$

Q_1 is True reactive power; D is Budeanu's distortion power.

$Q' = \sqrt{Q_1^2 + D^2}$ is Generalized reactive power.

In a pure sinusoidal system, since Budeanu's distortion power is 0, Generalized reactive power equals True reactive power. However, in a non-sinusoidal system, Generalized reactive power is larger than True reactive power.

Acuvim 300 can measure the reactive power above.

Apparent Power (S): Total system apparent power

Power Factor (PF): System average power factor

Frequency (F): The phase voltage input is measured as the system frequency (priority is V1, V2, V3).

Energy: Acuvim 300 can measure energy, reactive energy and apparent energy.

Power Factor Standards: Acuvim 300 supports two standards -- IEC and IEEE. The factory default is IEC. The two standards are illustrated in Figure 3-65.

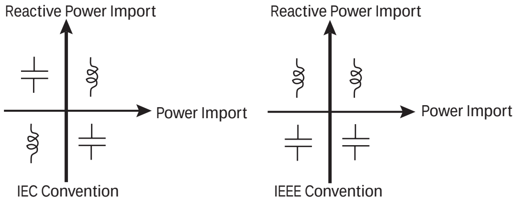


Figure 3-65 Power Factor Convention

Harmonic Parameters

Total Harmonic Distortion: this factor is often used to express the power quality of the power system. The formula is as follows:

$$THD = \sqrt{\sum_{h=2}^{50}\left(\frac{U_h}{U_1}\right)^2} \times 100\%$$

In the formula, U1 is Rms value of the voltage fundamental and Uh is Rms value ofthe voltage harmonic with order n.

Each Harmonic Rate: the percentage of each harmonic is divided by the fundamental. For Voltage,

$$HRUh = \frac{U_h}{U_1} \times 100\%$$

For Current,

$$HRIh = \frac{I_h}{I_1} \times 100\%$$

Demand:

Acuvim 398 uses sliding window method for demand calculation. It can measure current demand, power demand, reactive power demand and apparent power demand. Demand interval can be selected from 1 to 30 minutes. Demand window slides one minute each time. For example, the demand interval is set as 3 minutes. If the total power of the 1st minute is 12, the 2nd minute is 14 and the 3rd minute is 10, the total power demand of the 3 minutes is (12+14+10)/3=12.If another minute passed by (the 4th minute) and the total power for the minute is 9, the total power demand after 4 minutes, according to the 3 minute interval, should be (14+10+9)/3 = 11.

Max/Min:

Acuvim 398 meter can measure the max value of real system power, reactive power and apparent power and the max/min of the three phase voltage and current. The data is stored in non-volatile memory and can be accessed or cleared via meter front or communication.

Energy:

The energy measurement type includes Real-time energy measurement and Time of Use energy measurement. The function is described as follows:

Real time energy: the accumulation of energy for the system kWh, kvarh and kVAh since cleared last.

Time of Use energy: User can assign up to 4 diferent tariffs (Critical-peak, On-peak, Mid-peak, Off-peak) to different time period within a day according to the billing requirements. The meter will calculate and accumulate energy to different tariffs according to the meter's internal clock timing and TOU settings.

TOU setting: User can set a maximum of 12 TOU seasons, each season can be assigned to a TOU schedule (a maximum of 14 TOU schedules are available). Each schedule can be divided up into 14 segments (in which each segment can have its own tariff).

User can customize the TOU calendar (including its tariffs, seasons, schedules and segments) according to diferent applications. To make sure that the TOU calendar is setup correctly, the meter will check the TOU settings according to the predefined rules (see below for "TOU setting format requirement"for details).

TOU function will be disabled if the TOU calendar is set up incorrectly. If no errors are found in the calendar and the TOU function is enabled, TOU energy accumulation will begin.

TOU setting format requirments:

1.Season setting parameter: The calendar year will be divided up into different seasons depending on the season setting parameter. The parameter can be selected from any integer between 1 to 12.User must enter the correct value for the season setting parameter in accordance to the TOU season table. If the season setting parameter is set as 2, the first 2 slots of the TOU season table must be set, otherwise it will be considered as an invalid input (TOU function will be disabled).

2.Season format: Enter the start date into the TOU season table slot following this format "MM-DD ID" - MM stands for the month, DD stands for the day and ID stands for the TOU schedule ID (available from 01 to 14). The dates should be organized so that they are in sequence according to the calendar year (the earlier date comes first and the later date comes last). For example, if 3 seasons are selected, the date parameters are January 1, June 6 and September 7, and TOU schedule 02, 01, 03 will be used respectively, the frst TOU season table slot shall enter 01-01 02, the second slot shall enter 06-06 01, and the third slot shall enter 09-07 03.Entering 01-01 02 for the first slot, 09-07 03 for the second slot and 06-06 01 for the third slot is considered invalid.

3.Schedule setting parameter: The number of available TOU schedules depends on the schedule setting parameter. The parameter can be selected from any integer between 1 to 14.This parameter determines the number of TOU schedules available for the TOU calendar setting. A maximum of 14 TOU schedules (from TOU Schedule #1 to TOU Schedule #14) can be used.

4.Segment setting parameter: Each TOU schedule consists of various timing segments. The number of segments depends on the segment setting parameter setup. The parameter can be selected from any integer between 1 to 14 (inclusively). User must enter the correct value for the segment setting parameter in accordance to the TOU schedule table. If the segment setting parameter is set as 3, the frst 3 slots of the TOU schedule table must be set, otherwise, it will be considered as an invalid input (TOU function will be disabled).

5.Tariff setting parameter: Tariff setting is any integer between 0 and 3.It represents the maximum number of tariffs used in TOU energy measurement. For instance, if the tariff setting parameter is set to 3, all of the 4 tariffs will be available; if the parameter is set to 1, only the frst 2 tariffs (Critical-peak and On-peak) will be available; When tariffs number is set, it still needs to be set in Schedule settings, where the tariff will be set as any one of 0, 1, 2, 3 (0 means Critical-peak, 1 means On-peak, 2 means Mid-peak, 3 means Off-peak).

6.Holiday setting parameter: This parameter can be set from any integer between 1 and 30, meaning a maximum of 30 holidays can be programmed to the TOU calendar. If the holiday setting parameter is set as 3, the frst 3 slots of the holiday schedule must be set, otherwise it will be considered as an invalid input (TOU function will be disabled).

Note: User can either customize the TOU calendar factory settings or use thedefault factory settings. User can reset the TOU calendar to its default value either via communication.

TOU Holiday Use: Firstly set the holiday number, then set the specific holiday, the format is MM-DD Schedule ID. When the meter clock is within the set schedule ID, energy will be accumulated with the tariff associated with the set schedule.

Note: Holiday schedule has the highest priority among all the schedules.

Weekend schedule: When Weekend schedule is set as 0, it is disabled. When Weekend schedule is set as 1, it means Sunday effective. When Weekend schedule is set as 2, it means Saturday effective. When weekend schedule is set as 3, it means both Saturday and Sunday effective. When Weekend schedule is enabled, bit0 means Sunday; bit1~bit6 mean Week 1 to Week 6.When the meter clock is within the period of weekly interval, energy will accumulate to the tariff associated with the weekend schedule setting.

Note: Weekend schedule's priority is followed by Holiday schedule. When Holiday schedule is not enabled, Weekend schedule has the highest priority, overiding the normal (weekday) schedule.

Ten-year Holiday setting: Users can preset holidays of next decade via the meter software. The holiday format is month/day/year; holiday code; holiday schedule. After the format setup, click on "Make Holiday Settings (10 year)", then a holiday table for the next decade will be generated.

Holiday Auto Switch: When Ten-year Holiday is enabled, if the current year of the meter falls into the Ten-year Holiday setting, it automatically loads the Ten-year Holiday settings into the current TOU settings. If the current year of the meter does not fall into the Ten-year Holiday setting, it remains the current TOU settings.

Acuvim 398 can record maximum power and current demand under different tariffs, as well as the time stamp of the maximum value. It can also clear the maximum demand under different tariffs.

Daylight Saving Time(DST): When DST is enabled, there are two ways to adjust the clock to DST. If Fixed Date method is chosen, DST will be implemented by a fixed date and time, whose setting format is month/day/hour/minute/ adjustment(unit: minute). If Non-fixed Date method is chosen, DST will be implemented by which day of which week, whose setting format is month/which day (i. e. Tuesday)/which week (i. e. 1st week)/hour/minute/adjustment(unit: minute).

There are two ways of automatic resetting of current month TOU.

1.End of Month: This is the default method. All values from Current Month TOU will be copied over to Prior Month TOU at the very beginning of each month (the frst day of each month at time 00: 00: 00). Current Month TOU will be cleared and reset to 0.

2.Assigned Clock: User can select when the values from Current Month TOU would be copied over to Prior Month TOU. User can set the time in the following format “DD HH: MM: SS” - DD stands for day, HH stands for hour, MM stands for minute, SS stands for second. Similar to the previous method, once Current Month TOU is transferred to Prior Month TOU, all values from Current Month TOU will be cleared and reset to 0.

Chapter 4 Communication

This chapter will mainly discuss how to operate the meter via communication port using software. To master this chapter, you should be familiar with Modbus and read other chapters of this manual to make sure that you have a good understanding of the functions and applications of this product.

This chapter includes: Modbus protocol, format of communication and data address table.

4.1 Modbus Protocol Introduction

Modbus™ RTU protocol is used for communication. Data format and error check methods are deﬁned in Modbus protocol. The half duplex query and respond mode is adopted in Modbus protocol.

Modbus allows master device (PC, PLC etc.) to communicate with slave devices, not allow data exchange between slave devices. In that case, terminal devices will not engage the communcation link at initialization, only response the master's request.

1.Transmission mode

The mode of transmission defnes the data structure within a frame and the rules used to transmit data.

▲ Coding System	8 bit
▲ Start bit	1 bit
▲ Data bits	8 bit
▲ Parity	Odd, Even, No Parity
▲ Stop bit	1 bit/2 bit
▲ Error checking	CRC

2.Modbus protocol

2.1 Framing

Address	Function	Data	Check
8-Bits	8-Bits	N x 8-Bits	16-Bits

Table 4-1 Data framing format

2.2 Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 0-247 decimal. A master addresses a slave by replacing the slave address in the address feld of the message. When the slave sends its response, it places its own address in this address feld of the response to let the master know which slave is responding.

2.3 Function Field

The function code field of a message frame contains eight bits. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

Code	Meaning	Action
01	Read DO status	Obtain Digital (Relay) Output current status (ON/OFF)
02	Read DI status	Obtain Digital Input current status (ON/OFF)
03	Read data	Obtain current binary value from one or more registers
05	Control DO	Control Digital (Relay) Output(ON/OFF)
16	Preset multiple registers	Place specifc value into a series of consecutive multiple-registers

Table 4-2 Function Code

2.4 Data Field

Data field contains the data that terminals need to complete the request and the data that terminals response to the request.

Note: The sequence of Address, Function Code, Data, CRC check is always the same.

2.5 Error Check Field

The field allows the error check by master and slave devices. Due to electrical noise and other interference, a group of data may be changed transmitted from one location to the other. Error Check ensures master or slave devices do not reponse those distorted data during the transmission, which enhanced the system security and efficiency. Error Check uses 16-bit Cyclic Redundancy Check (CRC 16).

2.6 CRC Check

Every message includes an error checking field which is based on the Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes long, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, and is appended to the message.

The receiving device recalculates the CRC value during reception of the message, and compares the calculated value to the actual value it received in the CRC feld.

An error will be reported if the two values are not equal. CRC calculation is frst started by preloading the whole 16-bit register to 1's. The process begins by applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

When generating the CRC, each 8-bit character is exclusive ORed with the register contents. The result is shifted towards the least signifcant bit (LSB), with a zero □led into the most signifcant bit (MSB) position. The LSB is extracted and examined, if the LSB equals to 1, the register is exclusive ORed with a preset, □xed value; if the LSB equals to 0, no action will be taken. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The fnal contents of the register, after all the bytes of the message have been applied, is the CRC value. When the CRC is appended to the message, the low-order byte is appended frst, followed by the high-order byte.

4.2 Communication Format

Addr	Fun	Data start reg Hi	Data start reg lo	Data#of regs hi	Data #of regs lo	CRC16 Hi	CRC16 Lo
06H	03H	00H	00H	00H	21H	84H	65H

Table 4-3 Protocol Illustation

Addr: Slave device address
Fun: Function Code
Data start reg hi: Start register address, high byte
Data start reg lo: Start register address, low byte
Data #of reg hi: Number of register, high byte
Data #of reg lo: Number of register, low byte
CRC16 Hi: CRC high byte
CRC16 Lo: CRC low byte

1. Read Relay Output status(Function Code 01)

Query

The master device sends query frame to the salve deivce. Function Code 01 allows users to acquire the relay output status (ON/OFF) of the slave device with the speciﬁed address. On top of slave device address and function code, query frame must contain the relay register starting address and the number of registers to be read.

Table 4-4 depicts of reading Relay 1 and Relay 2 status of the slave device with the address of 17.

Addr	Fun	Data start reg Hi	Data start reg lo	Data#of regs hi	Data #of regs lo	CRC16 Hi	CRC16 Lo
11H	01H	00H	00H	00H	02H	BFH	5BH

Table 4-4 Query frame of reading Relay Output status

Response

The slave device anwsers the master device's query. The response frame contains slave device address, function code, data quantity and CRC check. Each relay utilizes one bit(1 = ON , 0 = OFF). Table 4-5 depicts the response frame.

Addr	Fun	Byte count	Data	CRC16 hi	CRC16 lo
11H	01H	01H	02H	D4H	89H

Data Bytes

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB LSB

(Relay 1 = OFF , Relay 2=ON) Table 4-5 Response frame of reading Relay Output status

2. Read the status of DI (Function Code 02)

Query

On top of slave device address and function code, query frame must contain the digital input register starting address and the number of registers to be read. DI register address starts from 0000H, DI1=0000H, DI2=0001H, DI3=0002H, DI4=0003H).

Table 4-6 depicts of reading DI1 to DI4 status of the slave device with the address of 17.

Addr	Fun	DI start addr Hi	DI start addr Lo	DI num Hi	DI num Lo	CRC16 Hi	CRC16 Lo
11H	02H	00H	00H	00H	04H	7BH	59H

Table 4-6 Query frame of reading DI status

Response

The slave device anwsers the master device's query. The response frame contains slave device address, function code, data quantity and CRC check. Each DI utilizes one bit(1 = ON , 0 = OFF). Table 4-7 depicts the response frame.

Table 4-7 depicts DI1=ON, DI2=ON, DI3=OFF, DI4=OFF.

Addr	Fun	Byte count	Data	CRC16 hi	CRC16 lo
11H	02H	01H	03H	E5H	49H

0	0	0	DI4	DI3	DI2	DI1
0	0	0	0	0	1	1

MSB LSB

Table 4-7 Response frame of reading DI status

3. Read Data (Function Code 03)

Query

This function allows the master to obtain the measurement results from the meter. The following table shows how to read the 3 measured data (F, V1 and V2) from slave device number 17, the data address of F is 0130H, V1 is 0131H and V2 is 0132H.

Addr	Fun	Data start addr hi	Data start Addr Lo	Data #of reg hi	Data #of regs lo	CRC16 lo
11H	03H	03H	00H	00H	03H	1FH

Table 4-8 Read F , U1, U2 query frame

Response

Response frame contains slave device address, function code, data quantity and CRC check.

(F=1388H(50.00Hz) , U1=03E7H(99.9V) , U2=03E9H(100.1V))

Addr	Fun	Byte count	Data1 hi	Data1 Lo	Data 2 hi	Data2 lo	Data3 hi	Data3 Lo	CRC16 hi	CRC16 lo
11H	03H	06H	13H	88H	03H	E7H	03H	E9H	7FH	04H

Table 4-9 Read F, U1, U2 response frame

4. Control Relay Output (Function Code 05)

Query

This query frame forces the relay status to ON or OFF. Data FF00H sets the relay as ON, and data 0000H sets the relay as OFF. The relay will not be influenced by any other data input.

The following is to query slave device 17 to set relay status as ON.

Addr	Fun	Do addr Hi	Do addr Lo	Value Hi	Value Lo	CRC16 Hi	CRC16 Lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table 4-10 Control relay status query frame

Response

The correct response to this request is to send back the received data after the relay status is changed.

Addr	Fun	Do addr Hi	Do addr Lo	Value Hi	Value Lo	CRC16 Hi	CRC16 Lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table 4-11 Control relay status response frame

5. Preset/Reset Multi-Register (Function Code 16)

Query

Function 16 (Hex) allows the user to modify the contents of multiple registers. The example below is a request to the address of 17 to Preset Ep_imp = (17807783.3 kWh). Since meter storage unit is 0.1 kWh, the number to write into is 178077833. and its HEX value is 0A9D4089H. Ep_imp data address is 0200H and 0201H.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of reg lo	Byte Count
11H	10H	02H	00H	00H	02H	04H

Value Hi	Value Lo	Value Hi	Value lo	CRC hi	CRC Lo
0AH	9DH	40H	89H	F8H	6CH

Table 4-12 Preset Muti-register query frame

Response

The correct response is to send back address, function code, data starting address, data bytes, CRC check after the value is changed.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of Reg lo	CRC16 hi	CRC16 lo
11H	10H	02H	00H	00H	02H	42H	E0H

Table 4-13 Preset Multi-reigster response frame

4.3 Communication Address Table

Basic Measurements

The data address of basic measurements includes Secondary data address(Table 4-14)and Primary data address (Table 4-16).

Basic Measurement (Secondary)				
Address	Parameter	Range	Data Type	Access Type
300H	Frequency F	0-65535	Word	R
301H	Phase A Voltage U1	0-65535	Word	R
302H	Phase B Voltage U2	0-65535	Word	R
303H	Phase C Voltage U3	0-65535	Word	R
304H	Average Phase Voltage Unavg	0-65535	Word	R
305H	Line Voltage U12	0-65535	Word	R
306H	Line Voltage U23	0-65535	Word	R
307H	Line Voltage U31	0-65535	Word	R
308H	Average Line Voltage Ull_avg	0-65535	Word	R
309H	Phase A Current I1	0-65535	Word	R
30AH	Phase B Current I2	0-65535	Word	R
30BH	Phase C Current I3	0-65535	Word	R
30CH	Average Phase Current Inavg	0-65535	Word	R

30DH	Neutral Line Current In	0-65535	Word	R
30EH	System Power P	-32768 - 32767	Integer	R
30FH	System Reactive Power Q	-32768 - 32767	Integer	R
310H	System Apparent Power S	0-65535	Word	R
311H	System Power Factor PF	-1000 - 1000	Integer	R
312H	Load Nature RT	76/67/82(L/C/R)	Word	R
313H	AO1 Output	0-65535	Word	R
314H	AO2 Output	0-65535	Word	R
315H	Phase A Current Demand	0-65535	Word	R
316H	Phase B Current Demand	0-65535	Word	R
317H	Phase C Current Demand	0-65535	Word	R
318H	Power Demand	-32768 - 32767	Integer	R
319H	Reactive Power Demand	-32768 - 32767	Integer	R
31AH	Apparent Power Demand	0-65535	Word	R

Table 4-14 Secondary side real-time measurement data address

Parameter	Relationship	Unit
Voltage	U=Rx × (PT1 / PT2) /10	V
Current	I=Rx ×(CT1/CT2) /1000	A
Power	P=Rx × (PT1 / PT2) × (CT1/ CT2)	W
Reactive Power	Q=Rx × (PT1 / PT2) X (CT1/ CT2)	var
Apparent Power	S=Rx × (PT1 / PT2) X (CT1/ CT2)	VA
Power Factor	PF=Rx / 1000	No Unit
Frequency	F=Rx / 100	Hz
Load Nature (L/C/R)	L/C/R is expressed by low byte	No Unit
Analog Output(Current Type)	AO = Rx /1000;	mA
Analog Output(Voltage Type)	AO = Rx /1000;	V

Table 4-15 Real time data conversion

Basic Measurement(Primary)			
Address	Parameter	Data Type	Access Type
600-601H	Frequency F	Float	R
602-603H	Phase A Voltage U1	Float	R
604-605H	Phase B Voltage U2	Float	R
606-607H	Phase C Voltage U3	Float	R
608-609H	Average Phase Voltage Unavg	Float	R
60A-60BH	Line Voltage U12	Float	R
60C-60DH	Line Voltage U23	Float	R
60E-60FH	Line Voltage U31	Float	R
610-611H	Average Line Voltage Ull_avg	Float	R
612-613H	Phase A Current I1	Float	R
614-615H	Phase B Current I2	Float	R
616-617H	Phase C Current I3	Float	R
618-619H	Average Phase Current Inavg	Float	R
61A-61BH	Neutral Line Current In	Float	R
61C-61DH	System Power P	Float	R
61E-61FH	System Reactive Power Q	Float	R
620-621H	System Apparent Power S	Float	R
622-623H	System Power Factor PF	Float	R
624-625H	Load Nature RT	Float	R
626-627H	Phase A Current Demand	Float	R
628-629H	Phase B Current Demand	Float	R
62A-62BH	Phase C Current Demand	Float	R
62C-62DH	Power Demand	Float	R
62E-62FH	Reactive Power Demand	Float	R
630-631H	Apparent Power Demand	Float	R

Table 4-16 Primary side real-time measurement data address

Data and Time Table

Function code: 03H for reading, 16H for presetting.

Address	Parameter	Range	Data Type	Access Type
500H	Year	2000-2099	Word	R/W
501H	Month	1-12	Word	R/W
502H	Day	1-31	Word	R/W
503H	Hour	0-23	Word	R/W
504H	Minute	0-59	Word	R/W
505H	Second	0-59	Word	R/W
506H	Week	0-6	Word	R/W

Table 4-17 Data and Time

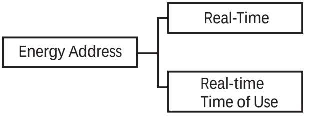
Energy

Function Code: 03H for reading, 16H for presetting.

Address	Parameter	Range	Data Type	Access Type
0200H(High)	Energy Ep	0-999999999	Dword	R/W
0201H(Low)				
0202H(High)	Reactive Energy Eq	0-999999999	Dword	R/W
0203H(Low)				
0204H(High)	Apparent Energy Es	0-999999999	Dword	R/W
0205H(Low)				

Table 4-18 Real-time energy data

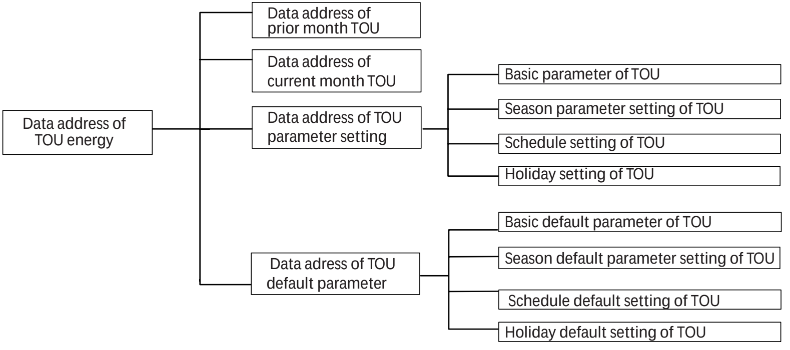
Acuvim 398 energy includes real-time energy and Time of Use energy.



Real-Time energy address is in Table 4-18.

Time of Use Energy

TOU energy addresses include data address of last month TOU energy, data address of current month TOU energy, data address of TOU parameter settings and data address of TOU default parameters. Except for the data address of TOU default parameter, the data address could be read by function code 03, preset by function code 16.TOU default parameter can be read by function code 03, preset by function code 176.



Prior Month TOU Energy (03H-Read, 10H-Write)				
Address	Parameter	Range	Data Type	Access Type
206H(High) 207H(Low)	Ep_TOU(Critical-peak)	0-999999999	DWord	R/W
208H(High) 209H(Low)	Eq_TOU(Critical-peak)	0-999999999	DWord	R/W
20AH(High) 20BH(Low)	Es_TOU(Critical-peak)	0-999999999	DWord	R/W
20CH(High) 20DH(Low)	Ep_TOU(On-peak)	0-999999999	DWord	R/W
20EH(High) 20FH(Low)	Eq_TOU(On-peak)	0-999999999	DWord	R/W
210H(High) 211H(Low)	Es_TOU(On-peak)	0-999999999	DWord	R/W
212H(High) 213H(Low)	Ep_TOU(Mid-peak)	0-999999999	DWord	R/W
214H(High) 215H(Low)	Eq_TOU(Mid-peak)	0-999999999	DWord	R/W
216H(High) 217H(Low)	Es_TOU(Mid-peak)	0-999999999	DWord	R/W
218H(High) 219H(Low)	Ep_TOU(O□-peak)	0-999999999	DWord	R/W
21AH(High) 21BH(Low)	Eq_TOU(O□-peak)	0-999999999	DWord	R/W
21CH(High) 21DH(Low)	Es_TOU(O□-peak)	0-999999999	DWord	R/W
21EH(High) 21FH(Low)	Ep_TOU(Total)	0-999999999	DWord	R/W
220H(High) 221H(Low)	Eq_TOU(total)	0-999999999	DWord	R/W

222H(High) 223H(Low)	Es_TOU(total)	0-999999999	DWord	R/W

Prior Month TOU Energy(03H-Read, 10H-Write)				
Address	Parameter	Range	Data Type	Access Type
224H(High) 225H(Low)	Ep_TOU(Critical-peak)	0-999999999	DWord	R/W
226H(High) 227H(Low)	Eq_TOU(Critical-peak)	0-999999999	DWord	R/W
228H(High) 229H(Low)	Es_TOU(Critical-peak)	0-999999999	DWord	R/W
22AH(High) 22BH(Low)	Ep_TOU(On-peak)	0-999999999	DWord	R/W
22CH(High) 22DH(Low)	Eq_TOU(On-peak)	0-999999999	DWord	R/W
22EH(High) 22FH(Low)	Es_TOU(On-peak)	0-999999999	DWord	R/W
230H(High) 231H(Low)	Ep_TOU(Mid-peak)	0-999999999	DWord	R/W
232H(High) 233H(Low)	Eq_TOU(Mid-peak)	0-999999999	DWord	R/W
234H(High) 235H(Low)	Es_TOU(Mid-peak)	0-999999999	DWord	R/W
236H(High) 237H(Low)	Ep_TOU(Off-peak)	0-999999999	DWord	R/W
238H(High) 239H(Low)	Eq_TOU(Off-peak)	0-999999999	DWord	R/W
23AH(High) 23BH(Low)	Es_TOU(Off-peak)	0-999999999	DWord	R/W

23CH(High)	Ep_TOU(Total)	0-999999999	DWord	R/W
23DH(Low)				
23EH(High)	Eq_TOU(Total)	0-999999999	DWord	R/W
23FH(Low)				
240H(High)	Es_TOU(Total)	0-999999999	DWord	R/W
241H(Low)				

Table 4-19 Time of Use energy address

The relationship between the communication data value and the real data value is listed below(Rx is the communication value):

Parameter	Relationship	Unit
Ep	Ep= Rx/10	kWh
Eq	Eq = Rx/10	kvarh
Es	Es = Rx/10	kVAh

Table 4-20 Energy data conversion table

TOU parameter setting addresses include Basic Parameters of TOU, Season Setting of TOU, Schedule Setting of TOU and Holiday Setting of TOU.

TOU Basic Parameter Setting (03H-Read, 10H-Write)				
Address	Parameter	Range	Data Type	Access Type
800H	Season Number	1-12	Word	R/W
801H	Schedule Number	1-14	Word	R/W
802H	Segment Number	1-14	Word	R/W
803H	Tari□ Number	0-3	Word	R/W
804H	Weekend Setting (bit0-Sunday; bit1~bit6: Monday~Saturday; bit=1 means using energy, bit=0 means not using energy)	0-127	Word	R/W
805H	Weekend Schedule	0-14	Word	R/W
806H	Holiday Number	0-30	Word	R/W

Season Setting			
820H-822H	Starting Date and Schedule of 1st Season (Month, Day, Schedule Number)	Word	R/W
823H-825H	Starting Date and Schedule of 2nd Season (Month, Day, Schedule Number)	Word	R/W
826H-828H	Starting Date and Schedule of 3rd Season (Month, Day, Schedule Number)	Word	R/W
829H-82BH	Starting Date and Schedule of 4th Season (Month, Day, Schedule Number)	Word	R/W
82CH-82EH	Starting Date and Schedule of 5th Season (Month, Day, Schedule Number)	Word	R/W
82FH-831H	Starting Date and Schedule of 6th Season (Month, Day, Schedule Number)	Word	R/W
832H-834H	Starting Date and Schedule of 7th Season (Month, Day, Schedule Number)	Word	R/W
835H-837H	Starting Date and Schedule of 8th Season (Month, Day, Schedule Number)	Word	R/W
838H-83AH	Starting Date and Schedule of 9th Season (Month, Day, Schedule Number)	Word	R/W
83BH-83DH	Starting Date and Schedule of 10th Season (Month, Day, Schedule Number)	Word	R/W
83EH-840H	Starting Date and Schedule of 11st Season (Month, Day, Schedule Number)	Word	R/W
841H-843H	Starting Date and Schedule of 12nd Season (Month, Day, Schedule Number)	Word	R/W
Schedule Setting			
844H-846H	Starting Time and Tari□ Number of 1st Scheule of 1st Schedule Table (Hour, Minute, Tari□ Number)	Word	R/W
847H-849H	Starting Time and Tari□ Number of 2nd Scheule of 1st Schedule Table (Hour, Minute, Tari□ Number)	Word	R/W

84AH-84CH	Starting Time and Tariff Number of 3rd Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
84DH-84FH	Starting Time and Tariff Number of 4th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
850H-852H	Starting Time and Tariff Number of 5th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
853H-855H	Starting Time and Tariff Number of 6th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
856H-858H	Starting Time and Tariff Number of 7th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
859H-85BH	Starting Time and Tariff Number of 8th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
85CH-85EH	Starting Time and Tariff Number of 9th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
85FH-861H	Starting Time and Tariff Number of 10th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
862H-864H	Starting Time and Tariff Number of 11st Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
865H-867H	Starting Time and Tariff Number of 12nd Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
868H-86AH	Starting Time and Tariff Number of 13rd Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
86BH-86DH	Starting Time and Tariff Number of 14th Scheule of 1st Schedule Table (Hour, Minute, Tariff Number)	Word	R/W
86EH-897H	Starting Time and Tariff Number of 1st~14th Scheule of 2nd Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
898H-8C1H	Starting Time and Tariff Number of 1st~14th Scheule of 3rd Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
8C2H-8EBH	Starting Time and Tariff Number of 1st~14th Scheule of 4th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W

8ECH-915H	Starting Time and Tariff Number of 1st~14th Scheule of 5th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
916H-93FH	Starting Time and Tariff Number of 1st~14th Scheule of 6th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
940H-969H	Starting Time and Tariff Number of 1st~14th Scheule of 7th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
96AH-993H	Starting Time and Tariff Number of 1st~14th Scheule of 8th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
994H-9BDH	Starting Time and Tariff Number of 1st~14th Scheule of 9th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
9BEH-9E7H	Starting Time and Tariff Number of 1st~14th Scheule of 10th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
9E8H-A11H	Starting Time and Tariff Number of 1st~14th Scheule of 11th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
A12H-A3BH	Starting Time and Tariff Number of 1st~14th Scheule of 12th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
A3CH-A65H	Starting Time and Tariff Number of 1st~14th Scheule of 13th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
A66H-A8FH	Starting Time and Tariff Number of 1st~14th Scheule of 14th Schedule Table (Hour, Minute, Tariff Number)	Same as 1st Schedule Table	R/W
Holiday Setting			
A90H-A92H	Holiday Date and Schedule Number of 1st Holiday (Month, Day, Schedule Number)	Word	R/W
A93H-A95H	Holiday Date and Schedule Number of 2nd Holiday (Month, Day, Schedule Number)	Word	R/W
A96H-A98H	Holiday Date and Schedule Number of 3rd Holiday (Month, Day, Schedule Number)	Word	R/W
A99H-A9BH	Holiday Date and Schedule Number of 4th Holiday (Month, Day, Schedule Number)	Word	R/W
A9CH-A9EH	Holiday Date and Schedule Number of 5th Holiday (Month, Day, Schedule Number)	Word	R/W

Power Quality Parameter Settings

Function Code 03 to read.

Address	Parameter	Range	Data Type	Access Type
Voltage and Current THD				
400H	V1 or V12 THD_V1	0-10000	Word	R
401H	V2 or V31 THD_V2	0-10000	Word	R
402H	V3 or V23 THD_V3	0-10000	Word	R
403H	I1 THD_ I1	0-10000	Word	R
404H	I2 THD_ I2	0-10000	Word	R
405H	I3 THD_ I3	0-10000	Word	R
The followings are voltage harmonics. The format of all voltage harmonics are the same.				
406H-423H	V1 or V12 harmonics(2nd to 31st order)	0-10000	Word	R
424H-441H	V2 or V31 harmonics	same as V1	Word	R
442H-45FH	V3 or V23 harmonics	same as V1	Word	R
The followings are current harmonics. The format of all current harmonics are the same.				
460H-47DH	I1 harmonics(2nd to 31st)	0-10000	Word	R
47EH-49BH	I2 harmonics	same as I1	Word	R
49CH-4B9H	I3 harmonics	same as I1	Word	R

Table 4-22 Harmonic Parameters

The relationship between communication value and actual value can be found below(Rx is the communication value)

Parameter	Relationship	Unit
THD	THD=Rx/10000×100%	No unit
Harmonic	THD=Rx/10000×100%	No unit

Table 4-23 Harmonic Data Conversion

DI Status

Function Code 02 to read.

Address	Parameter	Data	Access Type
0000H	DI1	1=ON, 0=OFF	Bit
0001H	DI2	1=ON, 0=OFF	Bit
0002H	DI3	1=ON, 0=OFF	Bit
0003H	DI4	1=ON, 0=OFF	Bit

Table 4-24 DI Address

Relay Output

Function Code 01 to read, Function Code 05 to control

Address	Parameter	Data	Access Type
0000H	Relay1	1=ON, 0=OFF	bit
0001H	Relay2	1=ON, 0=OFF	bit

Table 4-25 RO Address

System Parameters

Function Code 03 to read. Function Code 16 to set.

System Parameter Setting					
Address	Parameter	Range	Default	Data Type	Access Type
100H	Password	0-9999	0	Word	R/W
101H	Meter Address	1-247	1	Word	R/W
102H	Baud Rate	1200-38400	19200	Word	R/W
104H	Wire Mode	0-3Ln; 1-3LL; 2-2LL; 3-1Ln	0	Word	R/W
105H	PT1(High Byte)	50.0-1000000.0	400.0	Dword	R/W
106H	PT1(Low Byte)				
107H	PT2	50.0-400.0	400.0	Word	R/W
108H	CT1	1 or 50-50000	400.0	Word	R/W

109H	CT2	1 or 5	1 or 5	Word	R
10AH	Reactive Power	0: True: 1: Generalized	0	Word	R/W
10BH	VAR/PF Convention	0: IEC; 1: IEEE	0	Integer	R/W
10CH	Clear Energy	0x0A	0	Word	R/W
10DH	Backlight Time	1-5	5	Word	R/W
10EH	AO1 Parameter	0-17	0	word	R/W
10FH	AO1 Output Mode	0: 0-5V/0-20mA 1: 1-5V/4-20mA	0	Word	R/W
110H	AO2 Parameter	same as AO1	0	Word	R/W
111H	AO2 Output Mode	0: 0-5V/0-20mA 1: 1-5V/4-20mA	0	Word	R/W
112H	RO1 Mode	0-Voltage; 1-Digital; 2-Alarming; 3-Pulse;	0	Word	R/W
113H	RO1 Alarming Parameter	0-18	0	Integer	R/W
114H	RO1 Alarming setpoint	0-8000	0	Integer	R/W
115H	RO1 Alarming Delay	0-255	0	Integer	R/W
116H	RO1 Inequality	0: <; 1: >;	0	Integer	R/W
117H	RO2 Output Mode	0-Voltage; 1-Digital; 2-Alarming; 3-Pulse;	0	Word	R/W
118H	RO2 Alarming Parameter	0-18	0	Integer	R/W
119H	RO2 Alarming setpoint	0-8000	0	Integer	R/W
11AH	RO2 Alarming Delay	0-255	0	Integer	R/W
11BH	RO2 Inequality	0: <; 1: >	0	Integer	R/W

11CH	DO1 Energy	0: none; 1: kWh ; 2: kvarh	0	Integer	R/W
11DH	DO2 Energy	0: none; 1: kWh; 2: kvarh	0	Integer	R/W
11EH	DO Pulse Constant	800-6000	3600	Integer	R/W
11FH	Demand Window Size	1-30(min)		Word	R/W
120H	Clear Max Demand	0AH: clear; Others: not clear		Word	R/W
121H	Clear Demand of "Critical-peak"	0AH: clear; Others: not clear		Word	R/W
122H	Clear Demand of "On-peak"	0AH: clear; Others: not clear		Word	R/W
123H	Clear Demand of "Mid-peak"	0AH: clear; Others: not clear		Word	R/W
124H	Clear Demand of "O□-peak"	0AH: clear; Others: not clear		Word	R/W
125H	Clear Demand of "Total"	0AH: clear; Others: not clear		Word	R/W

Table 4-26 System Parameter Settings

Notes:

1.Data Type

“Bit”is binary value;

“Word” is 16-bit unsigned integer, using one register address, 2 bytes.

“Integer”is 16-bit signed integer, using one register address, 2 bytes.

“Dword”is 32-bit unsigned integer, using two register addresses, high bytes followed by low bytes, using 4 bytes in total.

“float”is single precision floating point, using two register addresses, 4 bytes.

2.Access Type

“R”is Read Only, using Function Code 03.

“R/W”is readable and writable, Write uses Function Code 10H. Writing into unlisted or non-writable registers is not allowed.

3.Real-time measurement data(0300H-0340H)need to be read with correct data type, range and relationship between communication value and real value.

4.The format of Energy and Meter Running Hours is 32-bit unsigned integer, high byte and low byte uses one address respectively. The software needs to use high byte to multiply 65535 and plus the low byte. The unit is 0.1 kWh or 0.1 kVarh or 0.1 kVAh.

Appendix

Appendix A Technical Data and Specification

Appendix B Ording Information

Appendix C Revision History

Digital Input	
Type	Wet contact
Max Input current	7.5mA
Input Voltage	16-30Vdc
Input Resistance	4kΩ
Isolation Voltage	2500V

Relay Output	
Type	Mechanical
Contact Resistance	100mΩ@1A
Switching Voltage	250Vac, 30Vdc
Max Break Current	5A
Withstand Voltage	4000Vac rms

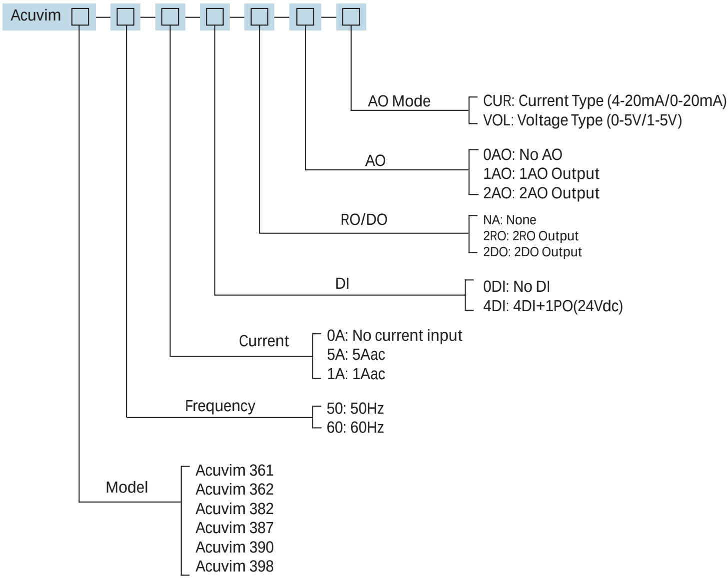
Digital Output	
Type	Photo-MOS, normally open
Isolation Voltage	2500Vac RMS
Max Working Voltage	100Vdc
Max Working Current	50mA
Energy Pulse Width	60ms

Analog Output		
Range	0-20mA/4-20mA, 0-5/1-5V	
Accuracy	0.5%	
Load Capacity	Voltage	Max Load Resistor , 20mA
	Current	Max Current, 500Ω

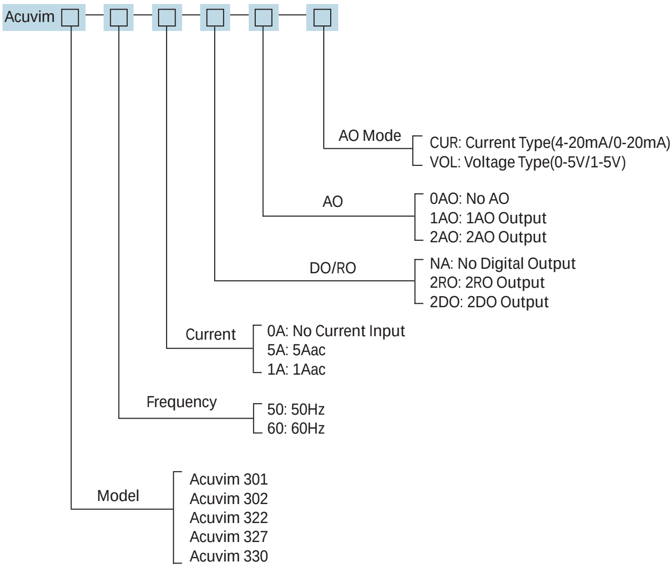
Standard Compliance	
Measurement Standard	IEC 61036 Class 1, IEC62053-21
Environmental Standard	IEC60068-2
Safety Standard	IEC61000-1
EMC Standard	IEC61000-4/2-3-4-5-6-8-11
Outline Standard	DIN43700

Suitable Conditions	
Dimensions(mm)	96×96×65(Cutout 92×92)
Protection Level	IP52(Front), IP20(Cover)
Weight(g)	500g
Operating Temperature	-25^{0}C - 70^{0}C
Storage Temperature	-40^{0}C - 85^{0}C
Humidity	5-95% non-condensing
Power Supply	100-415Vac, 50-60Hz, 100-300Vdc
Power Consumption	3W@230Vac
Elevation above Sea Level	2000 m

Appendix B Ording Information



Acuvim 300 Series Meter Ordering Example: Acuvim 390 - 60 - 5A - 4DI - 2RO - 1AO - CUR



Acuvim 300 Series Meter Ordering Example: Acuvim 330 - 60 - 5A - 2RO - 1AO - CUR

Appendix C Revision History

Version	Date	Description
V1.01	2011/11/1	1st Edition